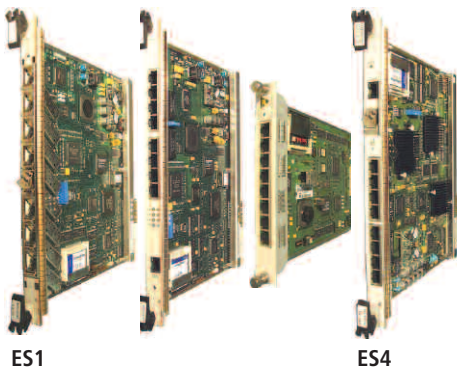


## Alcatel-Lucent ISA-ES1 and ES4 Series

INTEGRATED SERVICE ADAPTOR ETHERNET SWITCH (ISA-ES)  
FOR ALCATEL-LUCENT OMSN PRODUCTS

The Alcatel-Lucent Integrated Service Adaptor Ethernet Switch (ISA-ES) series circuit packs provide feature-rich Ethernet service capabilities for the undisputed market leaders of multiservice networks, the Alcatel-Lucent Optical Multiservice Network (OMSN) products.

ISA-ES1 and ES4 variants provide native Fast Ethernet (FE) and Gigabit Ethernet (GigE) interfaces and Ethernet over SDH (EoS) ports within 1-Gb to 2.5-Gb switching engines.



The Alcatel-Lucent OMSN family of multiservice nodes are deployed worldwide. The ISA-ES modules, with their capability to aggregate and switch Ethernet into SDH transport, offer service providers a powerful tool to leverage their SDH investments to offer Ethernet services.

Carrier-grade Ethernet must conform to stringent performance standards with high availability and layered network and service management.

SDH infrastructures built on the Alcatel-Lucent OMSN products have powerful Quality of Service (QoS) management with high availability and resiliency. Integrated Ethernet services based on the ISA-ES are simple to implement with embedded end-to-end data-service management. The ISA-ES empowers network transformation for service providers seeking to gain maximum return from their network investments (see Figure 1).

Figure 1. End-to-end data-services management

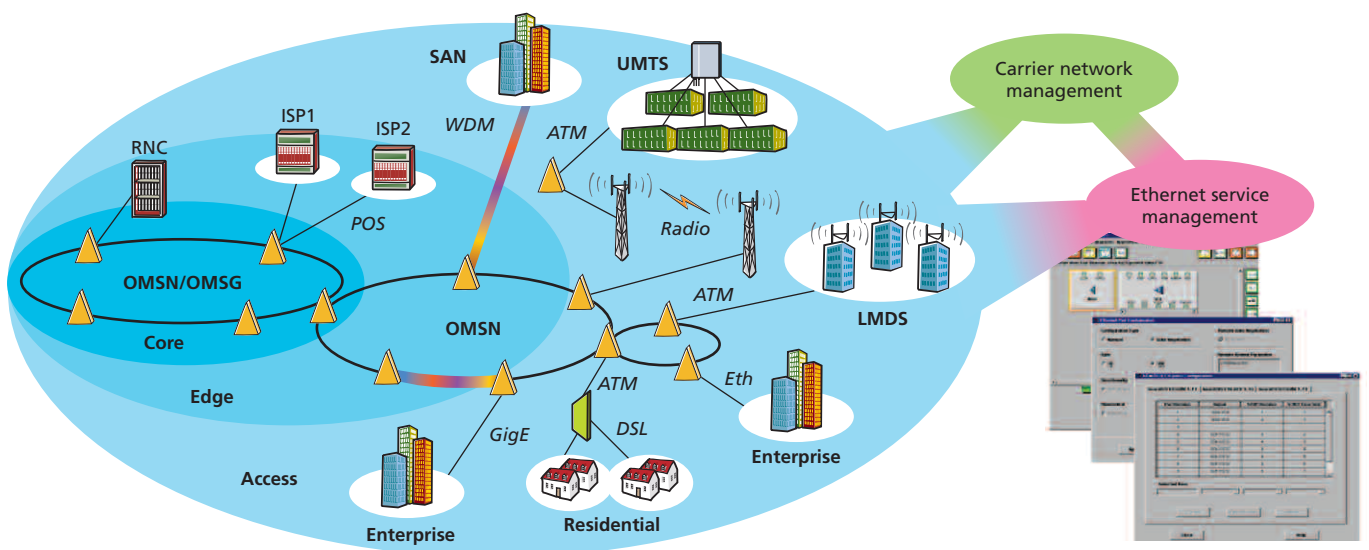
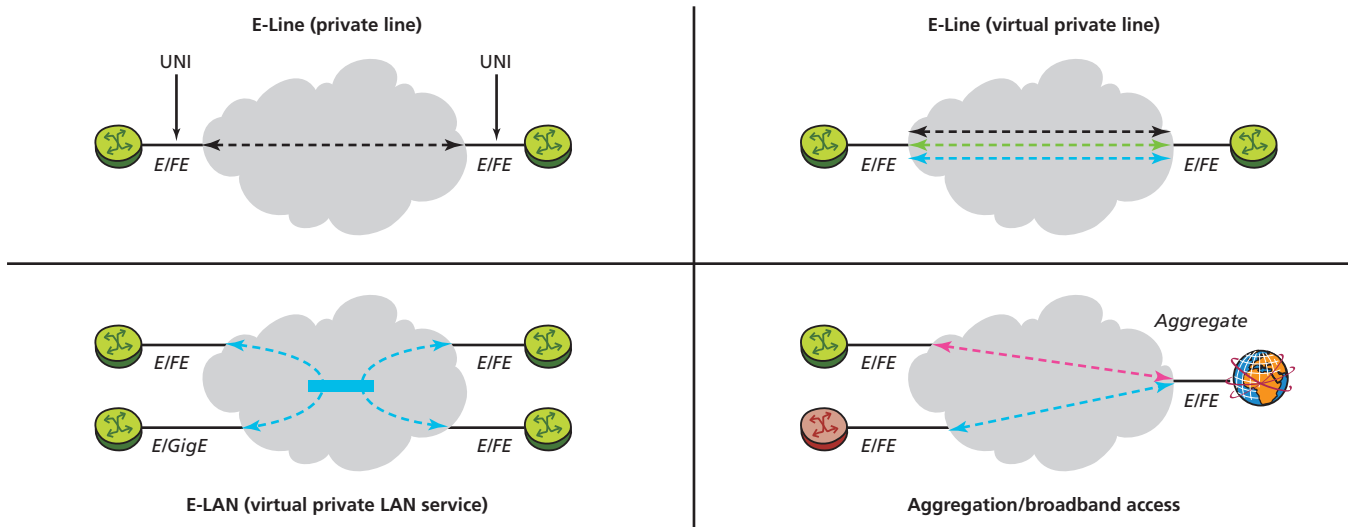


Figure 2. ISA-ES1/4: supported Ethernet services



The ISA-ES series meets the Ethernet technology needs of Tier-1 and Tier-2 service providers, service-provider carriers, multisystem operators or mobile service operators (MSOs), cable operators, power utilities and government institutions.

Each ISA-ES module has a configurable IP address and User Datagram Protocol (UDP) port for the network management to manage Ethernet services, including implementation, alarms retrieval and QoS Performance Monitoring (PM).

### ISA ES1 and ES4 circuit-pack overview

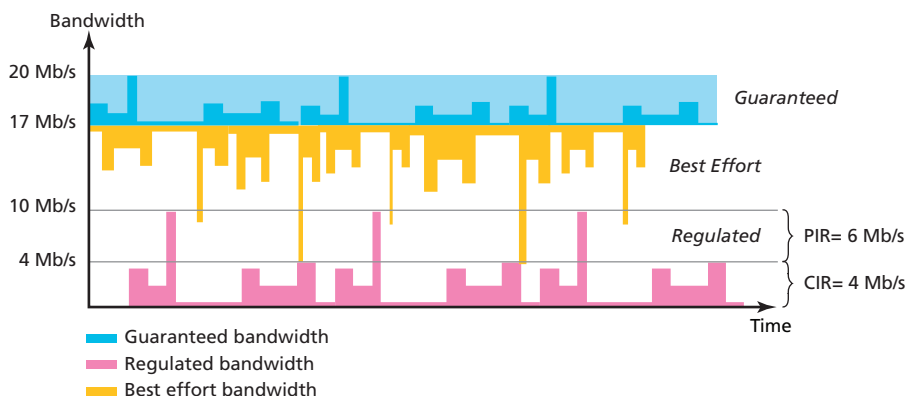
- Electrical and optical FE/GigE interfaces, with Small Form Factor Pluggable (SFP) optics
- A comprehensive set of:
  - Ethernet switching features (802.1d/Q/ad)
  - Resiliency features: xSTP, Link Aggregation Group (LAG), link capacity adjustment scheme (LCAS) and SDH-based protection
  - QoS features: for example, policing, priority marking, per class queuing and WDRR

- Ethernet PM counters
- Ethernet Operations, Administration and Maintenance (OA&M) suite (ITU-T Y.1731/IEEE 802.1ag)
- EoS adaptation suite, using generic framing procedure (GFP) (G.7041), link access procedure over SDH (LAPS), virtual concatenation (VCAT) (G.707) standards
- Flexible data architecture options (see Figure 2):
  - Point-to point
  - Hub and spoke
  - Multipoint-to-multipoint

- Optical transport options within OMSN products:
  - Multiplex section protection (MSP): 1+1, 1+N
  - Multiplex Section-Shared Protection Ring (MS-SPRING) 2f
  - Subnetwork Connection Protection (SNCP) I/N
- Efficient network management with dedicated Ethernet manager suite

To help meet service level agreements (SLAs), each ISA-ES module allows service providers and carrier operators to specify per flow QoS. Traffic is specified by a set of parameters to control its maximum and mean rates and the relative burst window size in bytes (see Figure 3).

Figure 3. SLA support



Policing parameters are specified according to:

- Committed information rate (CIR)
- CIR burst window size (CBS)
- Peak information rate (PIR), or excess information rate
- PIR burst window size (PBS)

Supported SLAs in ES1 and ES4:

- Guaranteed traffic
- Best effort traffic
- Regulated traffic

The Alcatel-Lucent ISA-ES1 and ISA-ES4 modules support one (1) and four (4) virtual container (VC)-4s aggregate trunk-

ing capacity respectively (see Figure 4 and Figure 5). The ISA-ES1 supports three (3) or eight (8) E/FE ports and the ISA-ES4 supports eight (8) E/FE ports and one (1) GigE port. The ISA-ES modules can be configured to support a wide range of VC-12, VC-3 and VC-4 combinations for flexible, full featured Ethernet over SDH. Figure 6 charts the aggregate bandwidth transported for various VC-X x Nv VC concatenation combinations on an ISA-ES. Table 1 presents a detailed view of the ISA-ES capacities in terms of maximum VC-12/3/4, VC groups (VCG) by VC-12/3/4 and VC-12/3/4 per VCG.

Hosting from one to several ISA-ES cards, the possible OMSN equipment configurations are outlined in Tables 2 and 3. The total number of Ethernet (Eth)/FE per node is directly related to the number of hosted ISA cards. Where larger quantities of Eth/FE ports are required, the Alcatel-Lucent 1850 Transport Services Switch (TSS) family is an ideal fit. Tables 4 and 5 present a detailed view of the available ISA-ES modules and the Alcatel-Lucent OMSN equipment on which they are supported.

Figure 4. ISA-ES1, delivering 1 x VC-4 aggregate bandwidth

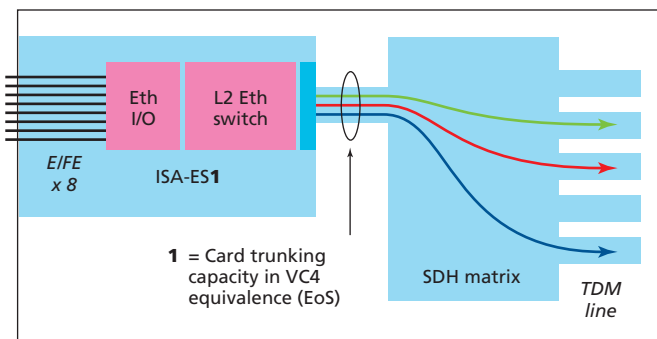


Figure 5. ISA-ES1, delivering 4 x VC-4 aggregate bandwidth

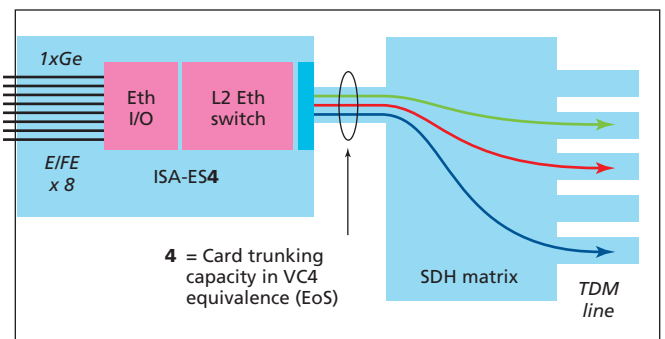
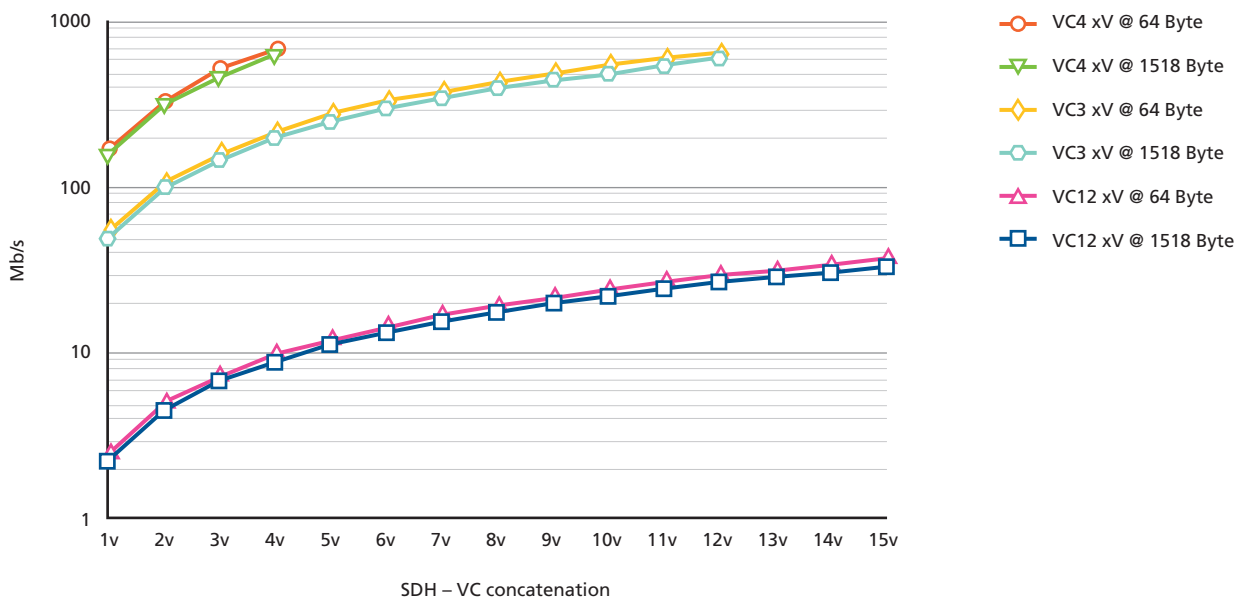


Figure 6. Transported bandwidth



**Table 1. Ethernet over SDH capacities**

EoS GigE OVER SDH (GoS)	ES 1 3 FE	ES 1 8 FE	ES 4 (EoS)	ES 4 (GoS)
EoS ports	3	8	16	2
VC-12 max available	63	63	252	252
VC-3 max available	3	3	12	12
VC-4 max available	—	1	4	4
VCG at VC-12	8	8	16	2
VCG at VC-3	3	2	12	2
VCG at VC-4	—	1	4	2
VC-12 per VCG	50	50	50	63
VC-3 per VCG	2	3	2	12
VC-4 per VCG	—	—	1	4

**Table 2. ISA-ES1 in OMSN equipment**

	TRUNK NETWORK	TRUNK BANDWIDTH	CARDS (maximum)	PORTS Eth/FE (minimum/maximum)	PORTS FX (minimum/maximum)	L2 BANDWIDTH (minimum/maximum)
1642 Edge Multiplexer Compact (EMC)	2 x Synchronous Transport Module (STM)-1	0.3 Gb/s	1	3/8	8	1 Gb/s
1642 Edge Multiplexer (EM)	2 x STM-4	1.2 Gb/s	2	3/16	8/16	1 Gb/s to 2 Gb/s
1640 Fiber Optics Extension (FOX)	2 x STM-4	1.2 Gb/s	1	8	8	1 Gb/s
1650 Synchronous Multiplexer Compact (SMC)	4 x STM-4	2.4 Gb/s	3	8/24	8/24	1 Gb/s to 3 Gb/s
1662 SMC	2 x STM-16	4.9 Gb/s	8	8/64	8/64	1 Gb/s to 8 Gb/s
1660 Synchronous Multiplexer (SM), Release 4	4 x STM-16	9.8 Gb/s	8	8/64	8/64	1 Gb/s to 8 Gb/s
1660 SM, R5	4 x STM-64	39.7 Gb/s	8	8/64	8/64	1 Gb/s to 8 Gb/s

**Table 3. ISA-ES4 in OMSN equipment**

	TRUNK NETWORK	TRUNK BANDWIDTH	CARDS (maximum)	PORTS Eth/FE (minimum/maximum)	PORTS GigE (minimum/maximum)	L2 BANDWIDTH (minimum/maximum)
1640 FOX	2 x STM-4	1.2 Gb/s	2	8/16	1/2	2.4 Gb/s to 4.8 Gb/s
1650 SMC	4 x STM-4	2.4 Gb/s	3	8/24	1/3	2.4 Gb/s to 7.2 Gb/s
1662 SMC	2 x STM-16	4.9 Gb/s	8	8/64	1/8	2.4 Gb/s to 19.2 Gb/s
1660 SM, R4	4 x STM-16	9.8 Gb/s	8	8/64	1/8	2.4 Gb/s to 19.2 Gb/s
1660 SM, R5	4 x STM-64	38.4 Gb/s	8	8/64	1/8	2.4 Gb/s to 19.2 Gb/s

**Table 4. ES1 ordering part numbers**

ISA-ES1	NAME	PORTS	FX ETHERNET (E)/FE	1642 EMC	1642 EM	1640 FOX	1650 SMC	1662 SMC	1660 SM R4	1660 SM R5
3AL 97243 AA**	ISA-LES1 3FE	2 + (1)	E/FE(FX)	•						
3AL 97194 AC**	ISA-ES1 3FE	2 + (1)	E/FE(FX)	•	•					
3AL 97165 AC**	ISA-ES1 8FE	8	E/FE	•	•					
3AL 98128 AC**	ISA-ES1 8FE	8	E/FE			•	•	•	•	•
3AL 98150 AC**	ISA-ES1 8FX	8 (SFP)	E/FE/FX			•	•	•	•	•

**Table 5. ES4 ordering part numbers**

ISA-ES4	NAME	PORTS E/FE	PORTS GigE	1642 EMC	1642 EM	1640 FOX	1650 SMC	1662 SMC	1660 SM R4	1660 SM R5
3AL 81879 AB**	ISA-ES4 8FE +1GigE	8	1			•	•	•	•	•

## Technical Specifications

### Interfaces

- FE: 10/100Base-T
- FX: 100Base-FX
- GE<sup>1</sup>: 1000Base-X

### Physical Ethernet interfaces

- 10/100Base-T:
  - Connectors: RJ-45
  - Transmission: full duplex
  - Range: 100 m (328.08 ft)
  - Ports: autonegotiation supported
- 100Base-X: SFP, LC connector
  - LX: 10 km – Single-Mode (SM) fiber
  - FX: 2 km – Multi-Mode (MM) fiber
- FE electrical SFP for Base-X
  - 100Base-T
  - Connector RJ-45
  - Range: 100 m (328.08 ft)
- 1000Base-X: SFP-based, LC connector
  - ZX: 80 km – SM fiber
  - LX: 5 km – SM fiber
  - SX: 550 m – MM fiber

### Ethernet switching features

- Technology
  - Application Specific Integrated Circuit (ASIC)-based
  - Parallel store-and-forward
- Bridging:
  - IEEE 802.1D: Media Access Control (MAC) bridge
  - IEEE 802.1Q: virtual bridge
  - IEEE 802.1ad provider bridge
- Class forwarding criteria
  - Per port
  - Per virtual LAN (VLAN) (802.1 Q)
  - Per priority bit (802.1 p)
  - 802.3 MAC DA
- Flow control as per IEEE 802.3
  - In full duplex only
- Address table
  - 8000 MAC entries
- Layer 2 switching core
  - ES1 = 1 Gb/s per card
  - ES4 = 2.4 Gb/s per card
- VLANs IDs per IEEE 802.1Q
  - 4094 VLAN IDs
  - Maximum 1000 active VLAN IDs

### Port trunking features

- EoS
  - GFP (G.7041)
  - LAPS
- VCAT (G.707) (See Table 1 EoS)
- Rate limiting per VCG (10 Mb or 100 Mb)

### Protection features

- STP, Rapid Spanning Tree Protocol (RSTP), LAG (FE/FX)
- Multiservice transport platform (MSTP) and, for VLAN applications proprietary per-VLAN RSTP
- LCAS (G.7042)
- SDH based
  - VC-x: SNCP-I/SNCP-N (<50 ms)
  - Multiplex section: MSP (<50 ms)

### Multicast features

- Internet Group Management Protocol (IGMP) proxy
- IGMP snooping V2

### QoS features

- Policer
  - Metering: single-rate policer token-bucket
  - Marking: two colors (green, yellow)
  - Dropping: out of profile
- Class of Service (CoS) classes
  - Best effort traffic: PIR >0 ; CIR=0
  - Guaranteed and regulated traffic with PIR=CIR >0
- Advanced QoS with IEEE 802.1p
- Differentiated services code points (DSCP) filtering/marketing
- Scheduler
  - Four output queues per port
  - Mixed strict priority (HOL) and weighted bandwidth queue
  - Deficit round robin
- Mapping of untagged traffic into a separate S-TAG

### Packet-based monitoring

#### Monitoring counters

- Total received correct octets (TRCO)
- Total received correct frames (TRCF)
- Total transmitted octets (TTO)
- Total transmitted frames (TTF)
- Total discarded frames (TDF) due to congestion
- Total received service errored frames (TRSEF)

#### Counters apply

- Per port: user network interface (UNI) and network node interface (NNI)
- Per flow (after classification)
  - Per VLANs: priority bits
  - Per classification: green, yellow
  - Unicast, Multicast and broadcast
- Per maintenance activity
  - Selection between all available counters

#### Historical of counter

- CD (current counters value)
- HD 1 h/15 min (historical of counters)
- HD 24 h (historical of 24 h counters)

#### OA&M features

- Metro Ethernet Fourm (MEF) OA&M includes end-to-end service fault discovery
  - Maintenance end point (MEP)
  - Maintenance intermediate point (MIP)
- Y.1731/IEEE 802.1ag implementation defines diagnostic fault localization procedures to check the connectivity of ports
  - Continuity check (CC)
  - Link trace (LT)
  - Link loopback (LB)
- Remote loopback for SDH trunks
- Client signal fail/server signal fail (CSF/SSF) propagation
- OA&M assisted by network management system

### Data certification

- MEF-9
- MEF-14

### Network management

- ISA is remotely managed through the Alcatel-Lucent 1350 Open Media Suite (OMS) Network Management suite made of:
- Element Manager (EMS)
  - Regional Manager (RM): SONET/SDH/ wavelength division multiplexing (WDM)
  - Packet Manager (PKT): data services
  - Standard management support includes
    - Open Systems Interconnection (OSI) stack with Q3 interface per SDH part of management
    - Simple Network Management Protocol (SNMP)v2c, SNMPv3 for Ethernet part of management
    - IP over OSI tunnelling: out-of-band management
    - Remote software download
    - Unsolicited alarm collection
    - Export of alarms through ISN and IOO interfaces
  - Operator's handbook suited for specific software release (on CD media)

### Local management

- Craft terminal PC-based for local management with
  - Microsoft Windows XP
  - Local interface (RS-232)
  - Local software download
- Operator's handbook suited for specific software release (on CD media)

### End-to-end: network managed services<sup>2</sup>

- Bridge (802.1D)
  - Ethernet private line (EPL)
  - Ethernet private LAN (E-LAN)
- Virtual bridge (802.1Q)
  - Ethernet virtual private line (EVPL)
  - Ethernet virtual private LAN (EVP-LAN)
- Provider bridge (802.1ad)
  - EVPL
  - EVP-LAN

1 ISA-ES4 only

2 Through 13500 MS PKT Bandwidth Manager management system

## IEEE standard compliance

- IEEE 802.1d Spanning Tree
- IEEE 802.1p Priority Queuing
- IEEE 802.1q VLAN Tagging
- IEEE 802.1w Rapid Spanning Tree
- IEEE 802.1s Multiple Spanning Tree
- IEEE 802.1ad Provider Edge Bridges
- IEEE 802.3ad Link Aggregation
- IEEE 802.1ag Ethernet OA&M
- IEEE 802.3 Ethernet Physical Layer
  - Clauses 24-25 100Base-T
  - Clauses 13-14 10Base-T
  - Clauses 28 Autonegotiation
- IEEE 802.3u FE
- IEEE 802.3x Flow Control
- IEEE 802.3z GigE
- IEEE 802.3ah Ethernet in First Mile

## IETF specifications

### General

- RFC 768 User Datagram Protocol
- RFC 783 Trivial File Transfer Protocol (TFTP)
- RFC 791 Internet Protocol
- RFC 792 Internet Control Message Protocol
- RFC 793 Transmission Control Protocol
- RFC 826 Ethernet Address Resolution Protocol
- RFC 854 Telnet Protocol Specification
- RFC 1122 Requirements for Internet HostsComm Lay
- RFC 1518 Classless Inter-Domain Routing
- RFC 1519 Classless Inter-Domain Routing
- RFC 1542/951 Clarifications and Extensions to the Bootstrap Protocol
- RFC 1812 Requirements for IPv4 Routers

### Differentiated Services (DiffServ)

- RFC 2474 Definition of the Differentiated Services Field (DS Field) in IPv4 and IPv6 Headers
- RFC 2475 DiffServ Core and Edge Routing Functions
- RFC 2597 DiffServe Assured Forwarding
- RFC 3140 Per Hop Behavior Identification (PHB) Codes
- RFC 3246/2598 Expedited Forwarding PHB

## Dimensions

- One basic card slot consuming in 1642 EM, 1642 EMC, 1640 FOX, 1650 SMC, 1662 SMC and 1660 SM

## Power supply

- -36-V to -75-V DC (-48-V)
- Redundant, hot-swappable
- Power consumption: 20 W maximum

## Environmental

- Class 3.2 ETSI: partly temperature-controlled locations

## Support information

Support for ISA-ES1 is provided through the Alcatel-Lucent Global Technical Support Organization with specifying information on hardware and software hosting equipment.

Please refer to [www.Alcatel-Lucent.com](http://www.Alcatel-Lucent.com) to contact Alcatel-Lucent's worldwide support organizations.

